(b) A group of piles has to support a vertical axial load of 2000kN. The piles are driven into clay and have a length of 10.5 m. The thickness of the clay stratum is 15 m. The clay is followed by rock. The saturated unit weight of clay is 19 kN/m^3 and its cohesion is 25 kN/m^2. The clay is normally consolidated and has a liquid limit of 60. Its specific gravity is 2.7. The water table is at the ground surface itself. Assuming the diameter of the piles as 300 mm, design a pile group. A factor of safety of 3 is required against shear failure. Compute its ultimate settlement. 25

(c) (i) What are the assumptions of Rankine's theory ? Derive the expressions for active pressure and passive pressure. 10

(ii) In a block test according to Indian Standards, resonant frequency of 18 HZ was observed in the vertical direction. The base size of the concrete test block is 1.50 m × 0.75 m. The thickness of the test block is 0.75 m. The unit weight of the concrete can be taken as 24 kN/m^3. Determine the co-efficient of elastic uniform compression. If a machine weighing 100kN is to be supported on a rigid block of 6m × 8m × 2.5 m, what is the natural frequency in vertical vibrations ? 15

Total No. of Printed Pages : 8 **Roll No. .....**

1(CCE.M)2

Civil Engineering–I

(06)

Time : Three Hours] [Maximum Marks : 300

INSTRUCTIONS

(i) Answers must be written in English.

(ii) The number of marks carried by each question is indicated at the end of the question.

(iii) The answer to each question or part thereof should begin on a fresh page.

(iv) Your answer should be precise and coherent.

(v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.

(vi) Candidates should attempt question no. **1** which is compulsory and any **three** more out of the remaining questions, selecting at least **one** question from each section.

(vii) If you encounter any typographical error, please read it as it appears in the text-book.

(viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.

(ix) No continuation sheets shall be provided to any candidate under any circumstances.

Contd.

5. (a) (i) Define Boundary Layer and explain the fundamental causes of its existence. 10

(ai) A plate 450 mm × 150 mm has been placed longitudinally in a stream of crude oil (Specific gravity 0.925 and kinematic viscosity of 0.9 stoke) which flows with velocity of 6 m/sec. Calculate :

(a) The friction drag on the plate

(b) Thickness of the boundary layer at the trailing edge, and

(c) Shear stress at the trailing edge. 15

(b) (i) Derive an expression for the loss of head due to friction in pipes. 10

(ii) In a pipe of diameter 300 mm the centre-line velocity and the velocity at a point 100 mm from the centre, as measured by Pitot tube, are 2.4m/sec and 2.0m/sec respectively. Assuming the flow in the pipe to be turbulent, find

(1) Discharge through the pipe

(2) Co-efficient of friction and

(3) Height for roughness projections. 15

(c) Uniform flow occurs at a depth of 1.5 m in a long rectangular channel 3 m wide and laid to a slope of 0.0009. If Manning's N = 0.015

Calculate :

(i) Maximum height of hump on the floor to produce critical depth.

(ii) Width of contraction which will produce Critical depth without increasing the upstream depth of flow. 25

(d) Design a T-beam to the following data, Clear span = 9.50m, bearing at each support = 400mm, spacing of beams = 3 mc/c, Live load on the floor = 3750 N/m^2, thickness of the floor slab

is 150 mm. Use M_{25} concrete and Fe_{415} steel. 25

SECTION–A

2. (a) Two columns 4.50 metres apart, between their centres, are to be provided with a combined footing. Each column carries a load of 1000 kN. The projection of the footing beyond the centre of each column is 1.25 metre. The columns are 400 mm × 400 mm each. Design the footing. The safe bearing capacity of the soil

is 200 kN/m^2. Use M_{15} concrete and Fe_{250} steel. 25

(b) A three hinged parabolic arch ACB is hinged at the supports A and B which are below the crown hinge C by 3 m and 6.75 m respectively. The span of the arch is 22.5 m. The arch carries a uniformly distributed load of 30 kN/m from A to C.

Find the reactions at the supports and the maximum positive and

negative bending moments. 25

(c) A pre-tensioned beam, 200 mm wide and 300 mm deep, is prestressed by 10 wires of 7 mm diameter initially stressed to

1200 N/mm^2 with their centroids located 100 mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing losses only for elastic shortening of concrete. If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of 5 percent of steel stress, estimate the final percentage loss of stress in the wires using the IS code (1343-1980) regulations, and the following data :

$E_S = 210\ kN/mm^2$ $E_C = 5700\ (f_{ck})^{1/2}$ $f_{ck} = 42 N/mm^2$

Creep Co-efficient (φ) = 1.6, Total residual shrinkage

strain = 3×10^{-4}. 25

Contd.

3. (a) Design a cantilever retaining wall to support a bank of earth 5 m high above the earth level at the toe of the wall. A building is to be built on the backfill. Assume that a 3 m surcharge will approximate the lateral earth pressure effect.

Given : Earth density = 17 kN/m^3 Angle of internal friction (repose) = 35º

Co-efficient of friction between concrete and soil = 0.45, Bearing

capacity = 150 kN/m^2 Use M_{15} mix and Fe_{415} steel. 25

(b) Analyse the continuous beam shown in Fig. 2, using flexibility method and draw the bending moment diagram. 25

diagram already take from MSS

(c) A column section ISHB 300 @0.630 kN/m with one cover plate 400 mm × 20 mm on either side is carrying an axial load of 2800 kN inclusive of self-weight of base and column. Design

a gusseted base. The allowable bending pressure in concrete is 4 N/mm^2. The allowable bending stress in base plate is

185 N/mm^2. 25

SECTION–B

4. (a) (i) A 30 cm × 15 cm Venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the Venturimeter is 30 cm. A

differential U-tube mercury manometer shows gauge deflection of 25 cm. Calculate :

(1) The discharge of oil, and

(2) The pressure difference between the entrance section and the throat section. Take the co-efficient of meter as 0.98 and specific gravity of mercury as 13.6.

20

(ii) Derive Bernoulli's equation for the flow of an incompressible frictionless fluid from consideration of momentum. 5

(b) (i) Explain the term'dimensionally homogeneous' equation. 5

(ii) A 7.2 m high and 15 m long spillway discharges 94 m^3/sec under a head of 2m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experiences a force of 7500N, determine force on the prototype. 20

(c) Laminar flow of a fluid of viscosity 0.9 Ns/m^2 and specific gravity 1.26 occurs between a pair of parallel plates of extensive width, inclined at 45° to the horizontal, the plates being 10 mm apart. The upper plate moves with a velocity of 2.0 m/sec relative to the lower plate and in a direction oppposite to the fluid flow. Pressure gauges mounted at two points 1 m vertically apart on the upper plate record pressures of 250 kN/m^2 and 80kN/m^{2-} respectively.
Determine :

(i) The velocity and shear stress distribution between the plates.

(ii) The maximum flow velocity and.

(iii) The shear stress on the upper plate. 25

Contd.

(x) Candidates shall put a cross (×) on blank pages of Answer Script.

(xi) No blank page be left in between answer to various questions.

(xii) No programmable Calculator is allowed.

(xiii) No stencil (with different markings) is allowed.

1. Answer any **three** of the following subdivisions, including (d) which is compulsory.

(a) Analyse the continuous beam loaded as shown in Fig. 1 by Kani's method. Sketch the bending moment diagram. 25

diagram already take from MSS

(b) The following system of wheel loads move from left to right

on a 15 m span, the 40kN load being leading. 25

Loads (kN)	20	60	60	50	40
Distance (m)	1.5		1.5	2.0	1.0

For a section C, 4 m from the left support, determine the :

(i) Maximum bending moment

(ii) Maximum shear force.

(c) (i) Explain in detail "logical IF" statement. 5

(ii) Write a FORTRAN program which reads a temperature in either Fahrenheit (or) degree centigrade and computes and prints the temperature in opposite scale. 20

SECTION—C

6. (a) A capillary permeability test was conducted in two stages under a head of 0.60 m and 1.80 m respectively, at the entry end. In the first stage, the wetted surface moved from 15 mm to 70 mm in 420 seconds. In the second stage, it advanced from 70 mm to 185 mm in 1440 seconds. The degree of saturation at the end of the test was 85% and the porosity was 35%. Determine the capillary head and the coefficient of permeability. 25

(b) (i) What are two different types of piping failures ? Explain with the help of sketches. 15

(ii) A sand deposit consists of two layers. The top layer is 2.5 m thick (ρ = 1709.67 kg/m^3) and the bottom layer is 3.5 m thick (ρ_{sat}= 2064.52 Kg/m^3). The water table is at a depth of 3.5 m from the surface and the zone of capillary saturation is 1 m above the water table. Draw the diagrams, showing the variation of total stress, neutral stress and effective stress. 10

(c) Describe various methods of drilling holes for subsurface investigations with the help of neat sketches. 25

7. (a) Compute the safe bearing capacity of a circular footing of diameter 1.5 m, located at a depth of 1.2 m in a cohesion less soil layer with an average saturated unit weight of 20 kN/m^3 and the angle of internal friction of 20º. The corresponding bearing capacity factors are given as follows. N_C = 17.7 N_q = 7.4 and N_r = 5.0. Assume :

(i) A suitable safety factor and

(ii) The water table is quite deep.

What will be the percentage reduction in the value if the water table rises to the surface due to unprecedented rainfall ? 25